

*Helping Massachusetts Municipalities Create a Greener Energy Future*

COMMONWEALTH OF MASSACHUSETTS



*Green Communities*

*Webinar*

*December 1, 2010*

*10:00 am*

## **Solar 101**

**Natalie Andrews**

**Renewables Energy Project  
Coordinator**

# Green Communities Division

Serves as the hub for all Massachusetts cities and towns on energy matters



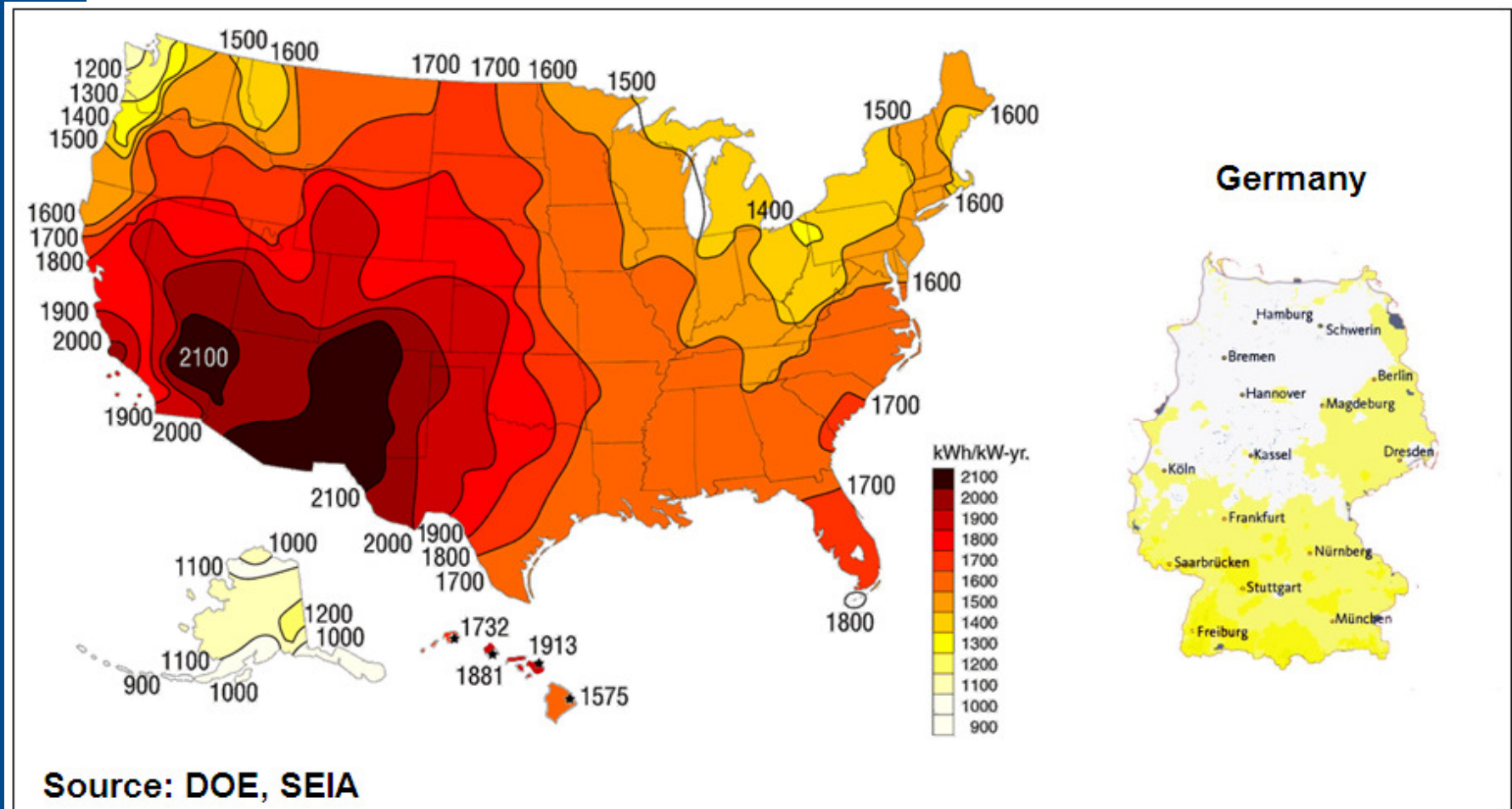
# Recording & Presentation

- The webinar is being recorded and will be available for viewing at your convenience. It will be posted on our website at:  
[www.mass.gov/energy/greencommunities](http://www.mass.gov/energy/greencommunities)
- The slide presentation will also be posted at:  
[www.mass.gov/energy/greencommunities](http://www.mass.gov/energy/greencommunities)
- Websites are also listed at end of presentation

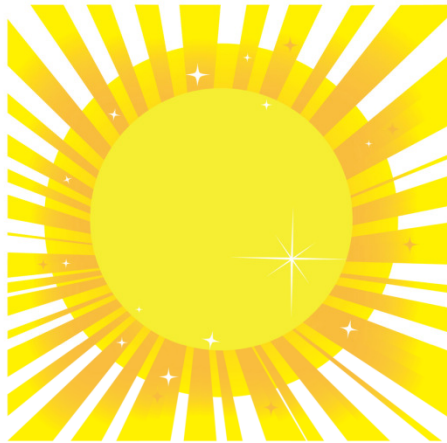
# Presentation Topics

- **Basics of solar photovoltaics**
- What makes for a good site?
- How to maximize incentives
- Basics of procurement

# Is there enough sun in Mass.?



# How does solar PV work?

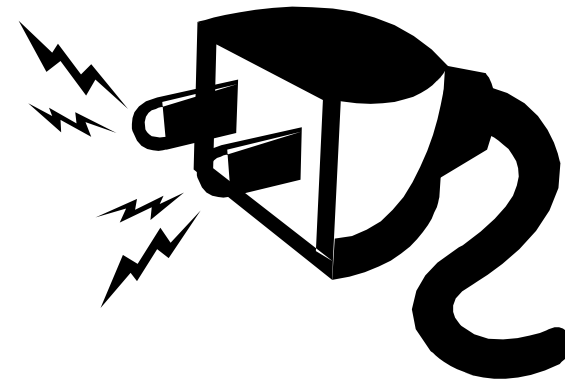


Sunlight

+



Semiconductor  
materials



=

Electricity

*Creating A Greener Energy Future For the Commonwealth*

# Inside a PV Cell

## Electron and Current Flow in Solar Cells

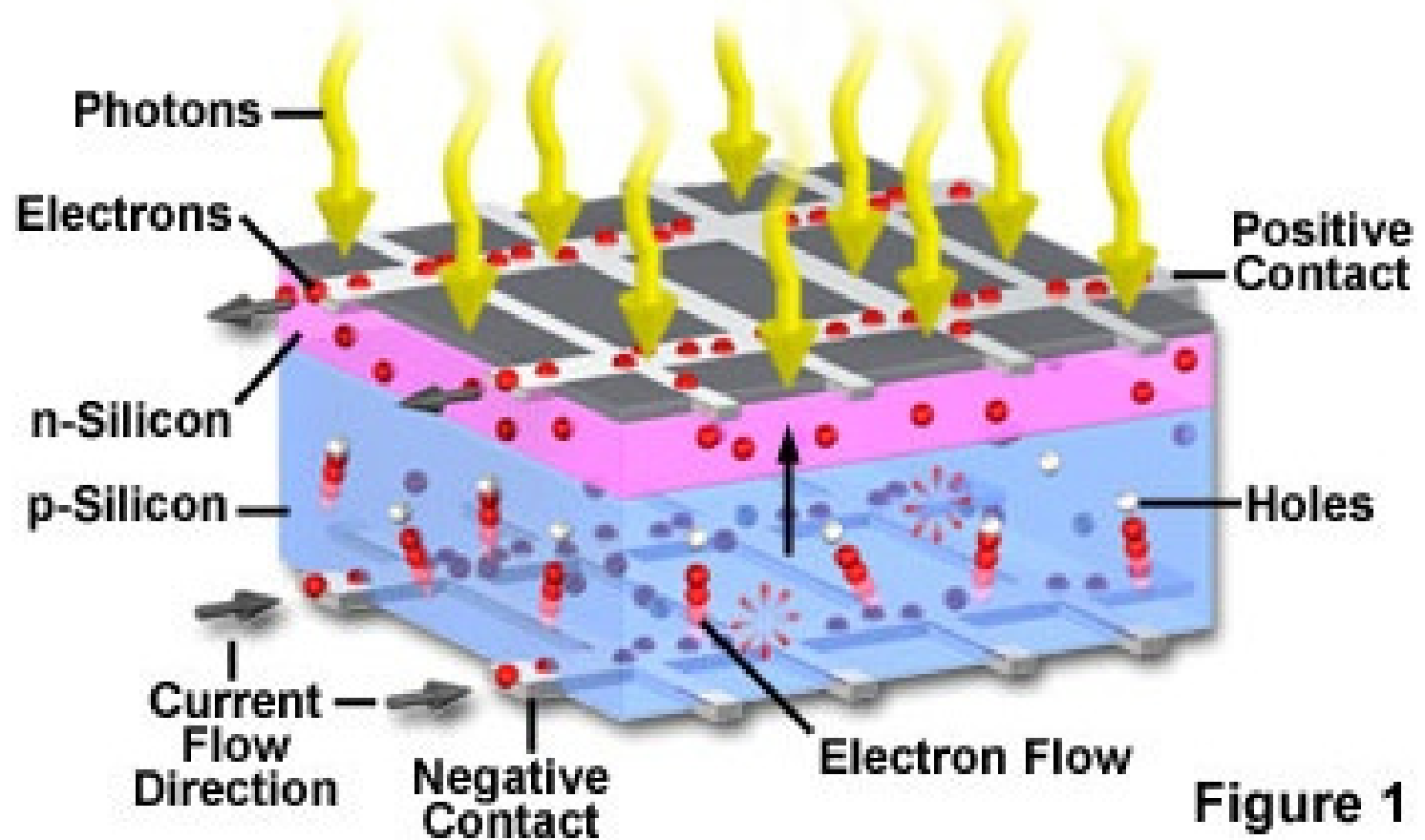


Figure 1

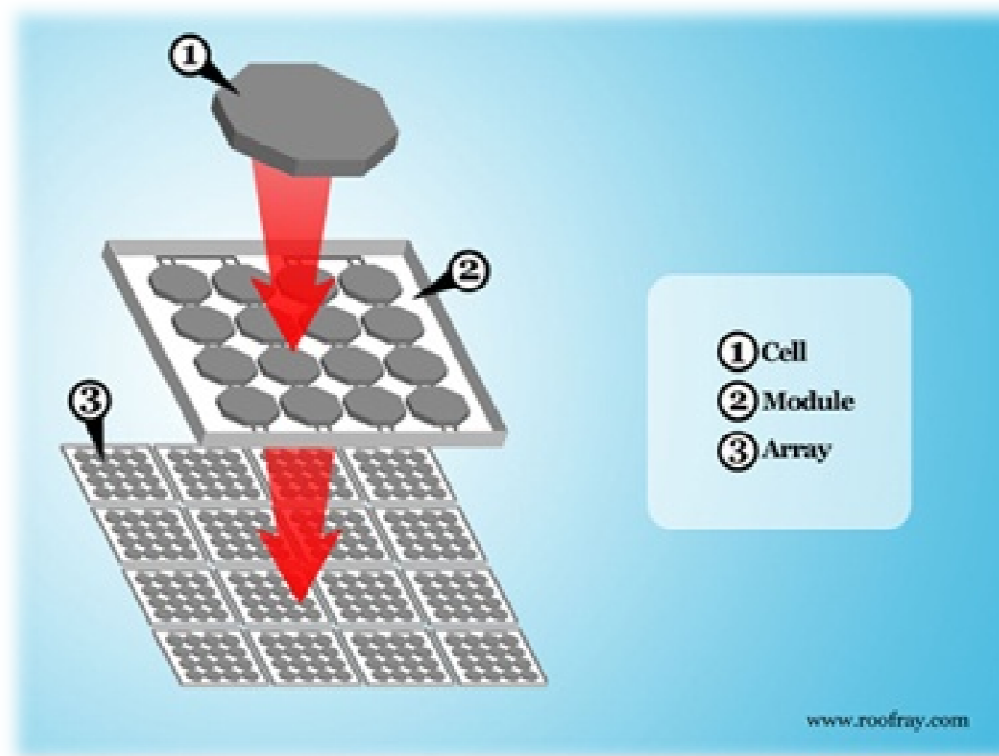
**DDER**

Massachusetts Department  
of Energy Resources

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# Photovoltaic (PV) Hierarchy

- Cell < Module < Array



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# Kilowatt Hours (kWh)

**NSTAR** Post Office Box 4508, Woburn, MA 01888-4508

Account Number  
12 6 0000025602 16 80 2085 536 1000 H

JANE SMITH  
26 ADDRESS STREET  
YOUR TOWN MA 02215-1617

NSTAR Electric

MOVING? PLEASE LET US KNOW, OTHERWISE YOU MAY BE RESPONSIBLE FOR ENERGY USE AFTER YOU MOVE.

Service Provided To:  
JANE SMITH  
26 ADDRESS STREET  
YOUR TOWN MA 02215-1617

80 2085 536 1000

**Electric Bill Comparison**

	Current Month	Last Month	Last Year
Electric Charges	\$256.02	\$314.13	\$299.35
Total Electricity Use (kWh)	1327	1622	2075
Delivery Charges (per kWh)	7.9¢	7.8¢	6.7¢
Cost to deliver electricity to your home.			
Delivery Charges Total	\$104.18	\$125.91	\$139.70
Generation Charges (per kWh)	11.4¢	11.6¢	7.7¢
Cost to purchase electricity on your behalf.			
Generation Total	\$151.84	\$188.22	\$159.65

**Bill Analysis**

	Current Month	Last Month	Last Year
Billing Days	26	30	28
Avg. Daily Electricity Use (kWh)	51.0	54.1	74.1
Avg. Daily Temp	71°	75°	75°

**Your Electricity Use By Month At A Glance**

16357

**Electric Bill Summary**

Account Number 2085 536 1000

Please Pay By September 18, 2006

Please Pay Amount \$256.02

Amount Enclosed

Current Bill Date August 23, 2006

Next Meter Read Date September 21, 2006

**Highlights From This Month's Billing Period**  
For July 26, 2006 to August 21, 2006

Amount of Your Last Bill .....\$314.13

Payment - Thank You .....-\$314.13

Adjustments.....\$0

Delivery Charges Total .....\$104.18

Generation Charges - Basic Fixed .....\$151.84

Total Cost of Electricity.....\$256.02

Please Pay Amount .....\$256.02

Welcome to NSTAR.

At NSTAR we're proud of you our 100-year tradition of providing safe and reliable electric and gas service to our 1.4 million customers, and we're proud to now serve your energy needs.

Please keep our toll-free number handy - 800-592-2000. Anytime you need to contact NSTAR this one phone number will do the trick.

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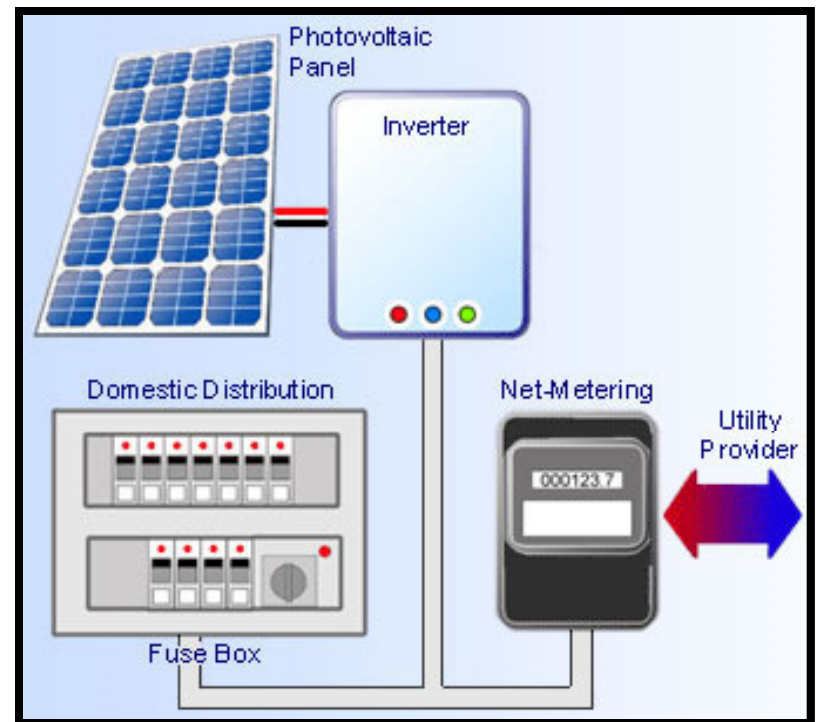
[www.nstar.com](http://www.nstar.com)

800-592-2000

**NSTAR** Post Office Box 4508, Woburn, MA 01888-4508

# Grid-Tied System

- Advantages
  - Easier to install and maintain
  - Less expensive
  - Grid can supply power
  - Feed excess electricity back to grid
- Disadvantages
  - No power if grid goes down



Source: Morningsolar Inc

# Presentation Topics

- Basics of solar photovoltaic
- **What makes for a good site?**
- How to maximize incentives
- Basics of procurement

# Solar Access

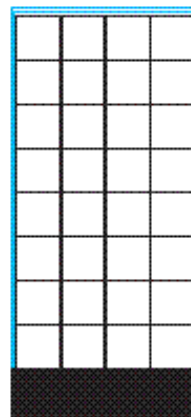
- Optimum Solar Window 9 AM – 3 PM
- Array should have NO SHADING in this window (or longer if possible)

Natural solar tracker

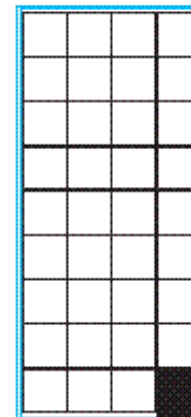


# Shading on Modules

- SHADING can half or even completely eliminate the output of a solar array!

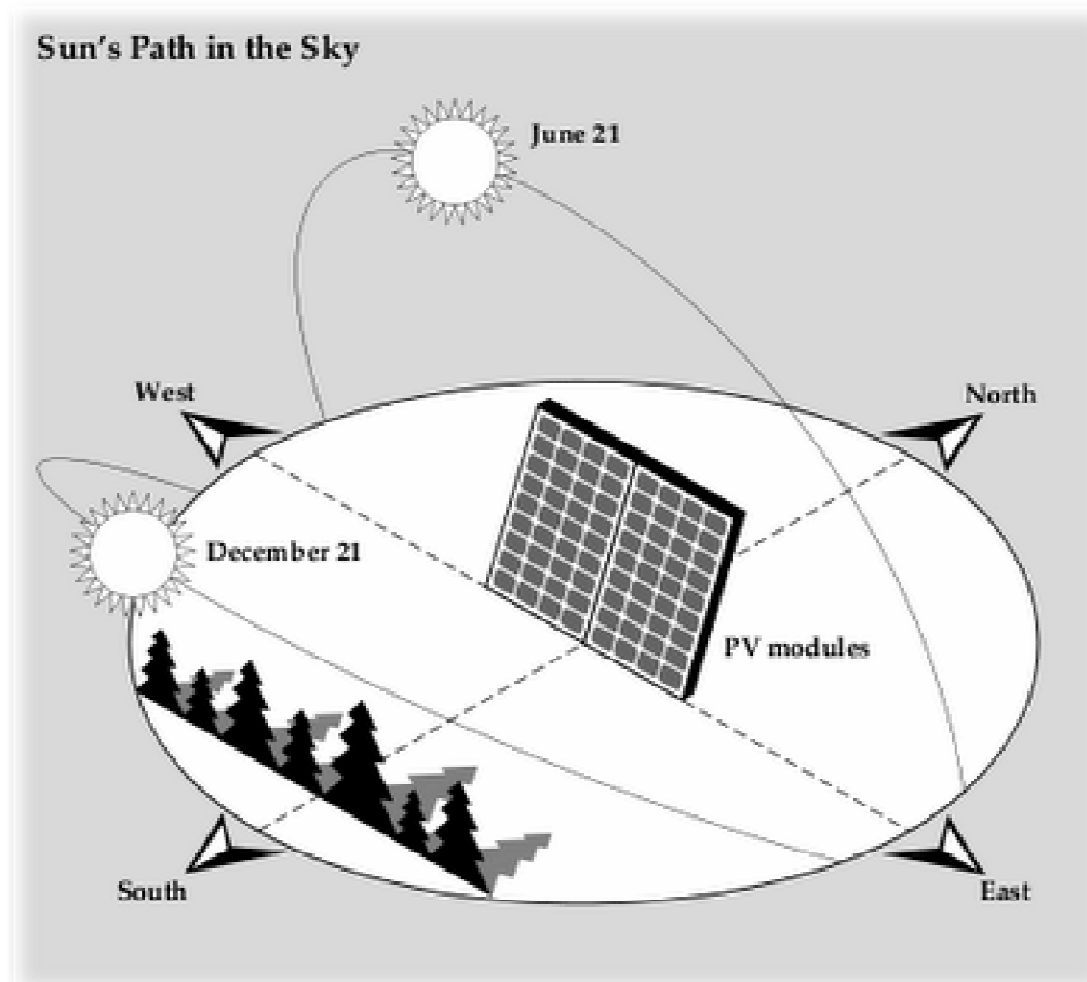


Example of full-cell shading that can reduce PV module power to zero



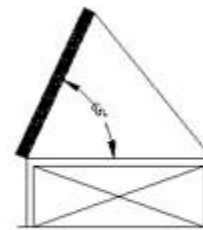
Example of full-cell shading that can reduce PV module power by  $\frac{1}{2}$

# Orientation

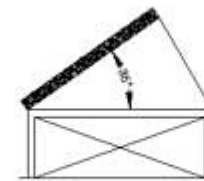


# Site Selection – Tilt Angle

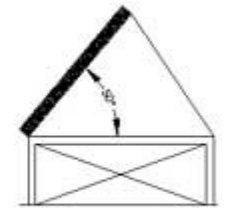
Max performance is achieved when panels are perpendicular to the sun's rays



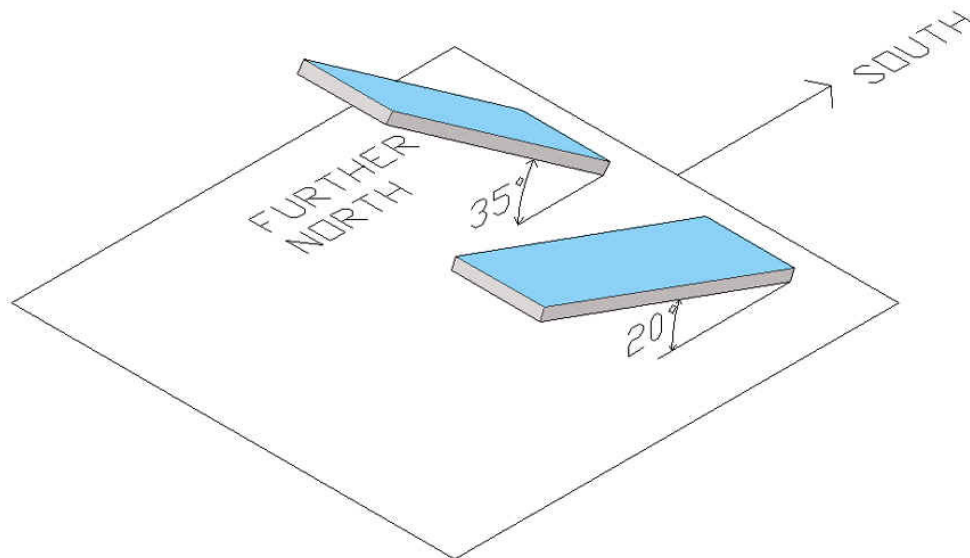
Winter



Summer



Year-Round



Year round tilt = latitude  
Winter + 15 lat.  
Summer – 15 lat.

For the Commonwealth

# General Considerations

- Access to an interconnection point nearby
- Accessibility to the inverter and solar array
- Insurance for the PV array
  - General Liability
  - Property Risk
  - Environmental Risk
  - Business Interruption



# Roof Mount Considerations

- Newer roof
- Structurally sound
- Penetrate the roof as little as possible
- Setbacks
- Leave 4-6" airspace between roof and modules
- On sloped roofs, fasten mounts to rafters not decking



# Ground Mount Considerations

- Flat is ideal
- Wind speed at the site
- Soil type and strength characteristics
- Perimeter fencing
- Theft
- Access
- Storm water runoff
- Landfill Sites there are additional considerations



WMECo Solar Array 1.8 MW

## Size

- Rule of thumb for open roof:  $150\text{ft}^2 = 1 \text{ kW}$
- Ground mount  $250 \text{ kW} = 1 \text{ acre}$
- Typical residential system would be anywhere from 1kW-7kW
- Incentives go up to 6 MW so “solar farms” will begin to be more popular
- IMBY <http://www.nrel.gov/eis/imby/>

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- Basics of procurement

## Massachusetts Solar (PV) Development Strategies

- Governor Patrick's goal – 250 MW by 2017
- Commonwealth Solar (Rebates) – initiated Dec. 2007
  - Rebate Program: \$68 million, 27 MW
  - Successfully achieved and completed Oct. 2009
  - Created robust PV development sector in MA
- Commonwealth Solar II (Rebates)
- Renewable Portfolio Standard (RPS) Solar Carve-Out – launched 1/1/2010
  - Creates Solar Renewable Energy Certificates (SRECs) to support solar development/financing
  - Targets solar growth to 400 MW
- Net metering
- Federal Government offers tax incentives and depreciation

# Purchase Options

- Outright purchase
  - Rebates, SRECs
- Land Lease
- Third party model with a Power Purchase Agreement (PPA)
  - Rebates, SRECs, state and federal tax incentives



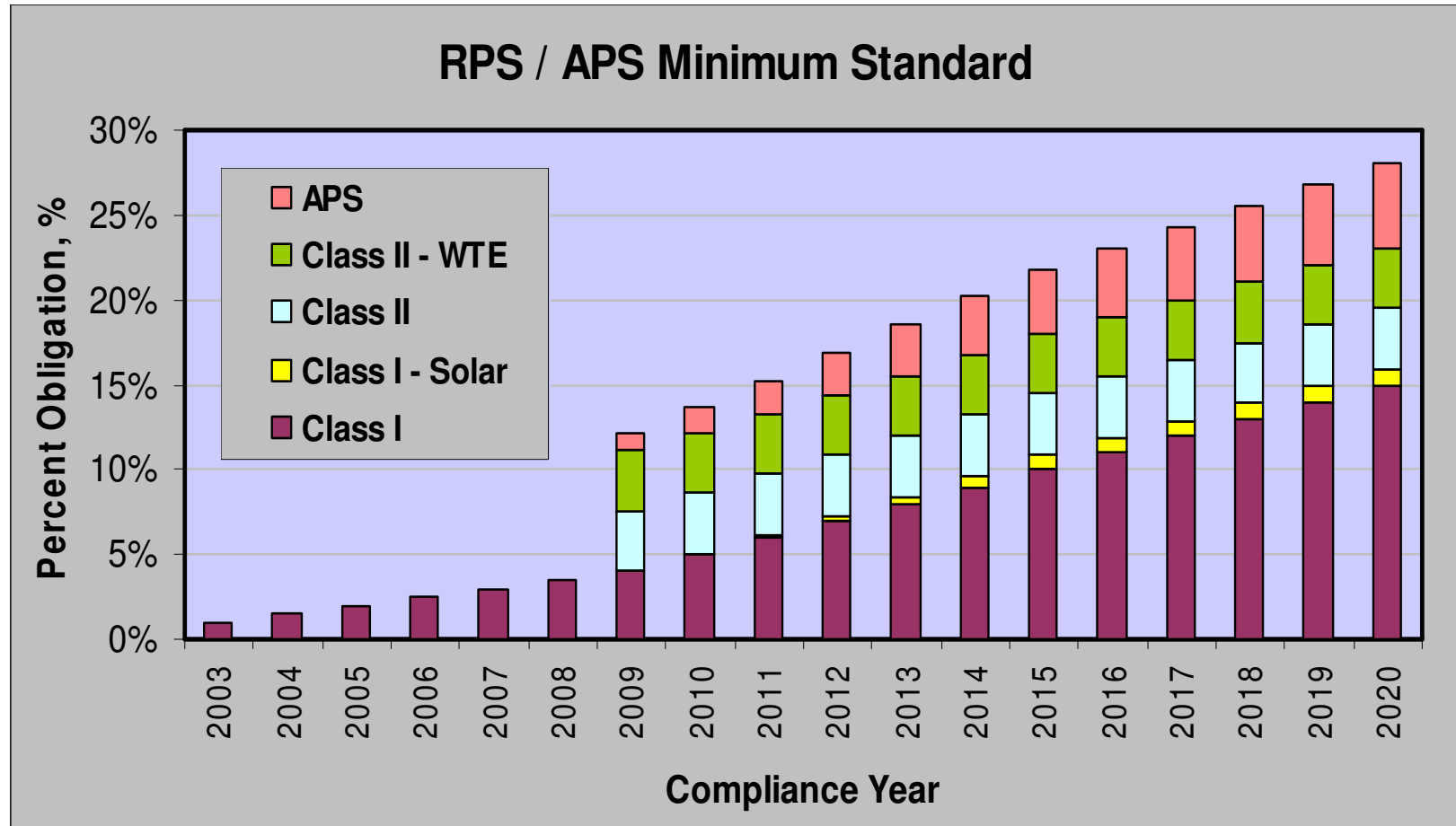
Oakmont Regional High School 16.8 kW

# Benefits of PPA

- No up-front cost
- Ability for tax-exempt entity to enjoy lower electricity prices thanks to savings passed on from federal tax incentives and SRECs
- A predictable cost of electricity over 15–25 years
- No need to deal with complex system design and permitting process
- No operating and maintenance responsibilities



# Cumulative Obligations of RPS / APS\* Programs



\*Alternative Portfolio Standard (APS)



# SREC Basics

- The RPS Solar Carve-Out is a market-based incentive
- Project eligibility criteria
- 1 SREC = 1,000 kWh of generation
- In 2010 require 30 MW = ~34,000 MWh must be met with Solar PV
- 30% growth rate if no triggers
- ACP rate of \$600/SREC
- Auction Account of \$285/SREC

## How much are SRECs worth?

- Between \$285 - \$600/SREC
- Aggregators and Brokers will charge a fee
- Example: 200kW project generates 249 SRECs a year at \$285 = \$70,965
- Example: 16.8 kW municipal project generates 20 SRECs @ \$285 = \$5,700
- Example: 5kW residential project generates 6 SRECs a year @ \$285 = \$1,710

### Welcome new User

Please enter your user information below. Required fields are marked with an asterisk (\*). Choose the type of application (RPSI,II,APS) first. When you have completely filled out the form, click the 'Submit' button. If you do not wish to register at this time, click the 'Cancel' button to return to the home page. Once you have successfully submitted your user information and become a registered user, you may proceed to the first SQA page by clicking the "Proceed to SQA" Button below.

Application Type:	*	<input type="text" value="Select AppType"/>
First Name:	*	<input type="text"/>
Last Name:	*	<input type="text"/>
Company / Org. Name:	*	<input type="text"/>
Title/Relationship:	*	<input type="text"/>
Company or Org. URL:		<input type="text"/>
Organization Type:	*	<input type="text" value="Select Organization Type"/>
Street Address:	*	<input type="text"/>
City:	*	<input type="text"/>
State:	*	<input type="text" value="Select State"/>
Zip Code:	*	<input type="text"/>
Phone:		<input type="text"/>
Mobile Phone:	*	<input type="text"/>
Fax:		<input type="text"/>
Email:	*	<input type="text"/>
Confirm Email:	*	<input type="text"/>

We respect your privacy and will keep your email address confidential. The email address is needed to communicate with you about your Application.

Username: \*

The Username must be 8-15 characters long. Username must not contain special characters or spaces.

Password: \*

Confirm Password: \*

The Password must be 8-10 characters long. Password must contain at least one digit and one alphabetic character, and must not contain special characters.

## Statement of Qualification Application Form

## User Registration

# RPS Solar Carve-Out Regulatory Update

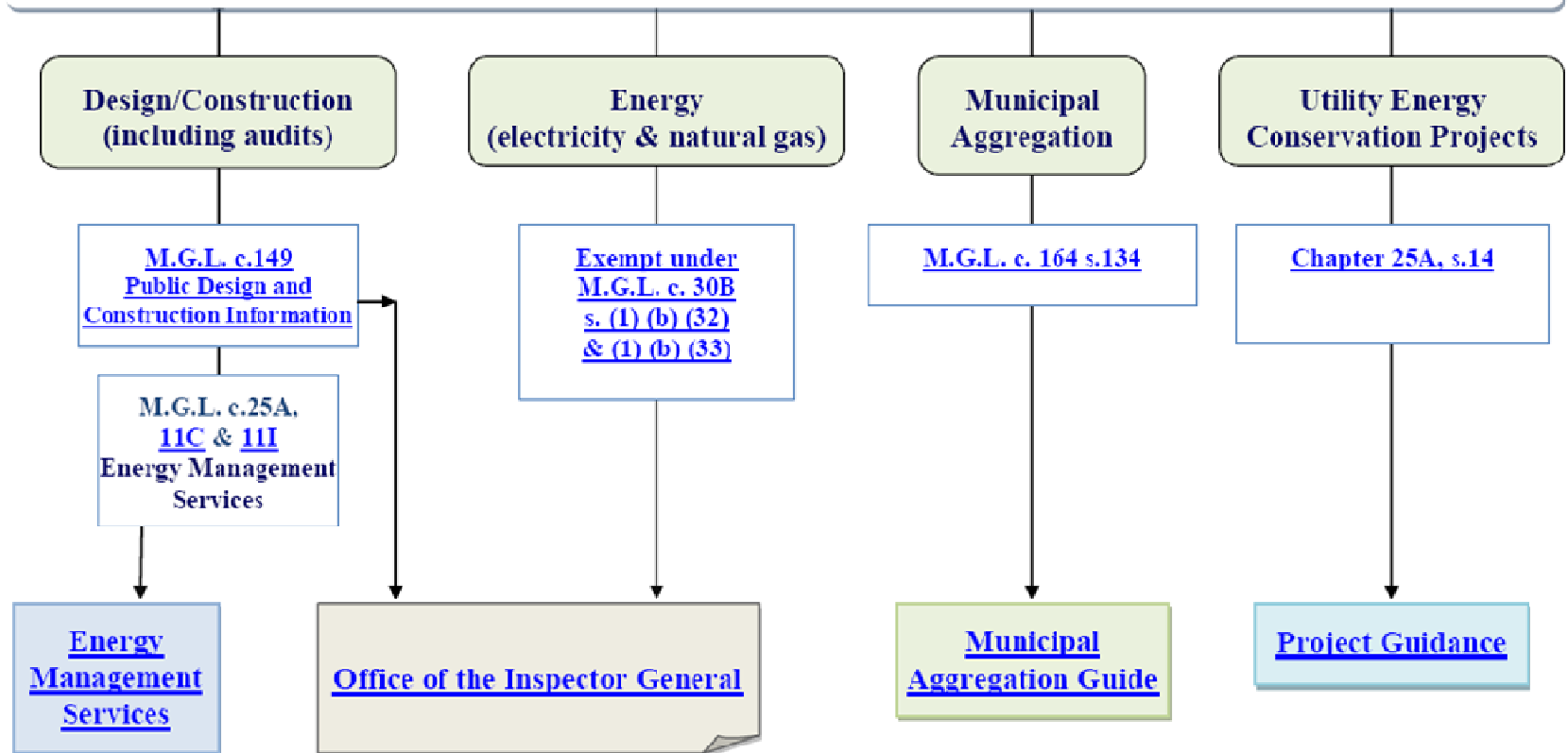
- DOER filed Emergency Regulations on 1/8/2010 to establish program and compliance obligation starting 1/1/2010.
- Public Hearing held March 2<sup>nd</sup> written comments were accepted.
- Final regulations filed soon
- Web-based Statement of Qualification Application (SQA) is available.
- <http://rps-aps.ene.state.ma.us/>

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- Basics of solar photovoltaic
- What makes for a good site?
- How to maximize incentives
- **Basics of procurement**

# Procurement laws

## Applicable Laws for Energy and Energy-Related Contracts in Municipalities



This chart provides relevant Massachusetts General Laws (M.G.L.) for energy contracts. Please contact Eileen McHugh at 617-626-7305 for more information.

# Procurement Process

- Select procurement path
- Issue solicitation/s
- Select winning bidder
  - Quality
  - Experience
- Handbook being developed for municipalities –  
*Developing PV on Closed Landfills*



Watertown DPW building 50 kW (PPA)

# Additional Resources

- Solar Basics
  - <http://apps1.eere.energy.gov/solar/cfm/faqs/>
  - <http://science.howstuffworks.com/environmental/energy/solar-cell.htm>
- IMBY- tool to calculate the size of a solar array
  - <http://www.nrel.gov/eis/imby/>
- Commonwealth Solar II
  - <http://www.masscec.com/index.cfm/pid/11159/cdid/11241>
- SRECs
  - <http://www.mass.gov/energy/solar>
- PPA Checklist for State and Local Governments
  - <http://www.nrel.gov/docs/fy10osti/46668.pdf>
- Procurement Assistance
  - **M.G.L. c. 25A**– [Eileen.McHugh@state.ma.us](mailto:Eileen.McHugh@state.ma.us)
  - For questions regarding procurement under **M.G.L. c. 30B**, call the Chapter 30B line five days a week at (617) 722-8838 from 9:00 A.M. to 4:30 P.M. For questions regarding procurement under **M.G.L. c. 149**, call the Attorney General's office, Deborah Anderson at 617-727-2200 ext. 2371 or Brian O'Donnell at 617-727-2200 ext. 2340.



# Thank you

Contact information:

**Natalie Andrews**

Renewable Energy Project Coordinator

[Natalie.Andrews@state.ma.us](mailto:Natalie.Andrews@state.ma.us)

617-626-7343

[www.mass.gov/doer](http://www.mass.gov/doer)

## OUTREACH - REGIONAL COORDINATORS

- Regional Coordinators act as direct liaisons with cities and towns on energy efficiency and renewable energy activities
- Located at each of the DEP Regional Offices:
  - SERO – LAKEVILLE: Seth Pickering
    - [Seth.Pickering@state.ma.us](mailto:Seth.Pickering@state.ma.us)
  - NERO – WILMINGTON: Joanne Bissetta:
    - [Joanne.Bissetta@state.ma.us](mailto:Joanne.Bissetta@state.ma.us)
  - CERO – WORCESTER: Kelly Brown
    - [Kelly.Brown@state.ma.us](mailto:Kelly.Brown@state.ma.us)
  - WERO – SPRINGFIELD: Jim Barry
    - [Jim.Barry@state.ma.us](mailto:Jim.Barry@state.ma.us)

# Green Communities Division Programs & Resources for Municipalities

- Green Communities Grant and Planning Assistance Program
- MassEnergyInsight System
- Municipal Energy Efficiency Program
- Energy Performance Contracting Technical Assistance
- ARRA Stimulus Funding
- Website filled with tools & resources for municipalities:  
[www.mass.gov/energy/greencommunities](http://www.mass.gov/energy/greencommunities)
- Email updates via listserv – Sign up today by send an email to:  
[join-ene-greencommunities @listserv.state.ma.us](mailto:join-ene-greencommunities@listserv.state.ma.us)